
PUBLIC WATER-SUPPLY:

WITH

SPECIAL REFERENCE

TO THE

REQUIREMENTS OF PERTH.

BY

W. LAUDER LINDSAY,

M.D., F.R.S.E.;

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IN complying with the invitation—through its excellent Secretary—of the Perthshire Society of Natural Science, to deliver a short Address on some suitable subject—if possible of *local interest*,—I have selected that of the *Water-supply of Perth and its Suburbs*, for the following reasons :—

(1.) A due knowledge of the sources, nature, and uses of Water-supply involves a knowledge of a considerable number of the *Sciences*, Natural and Physical, including, for instance, Geology, Petrology, or Mineralogy, Physical Geography, Meteorology, Chemistry, Botany, Zoology, Hydrology, Hydrostatics, Hydraulics; and, above all, that Science, which is so important in its practical bearings on Human Health and Happiness, which implies a knowledge of portions at least of so many others of the Sciences above-named, and which is rapidly becoming, as it deserves, more and more a subject of special study—*Sanitary Science*. It is from *ignorance* of these Sciences, or branches of Science, that so many *fatal mistakes* are constantly being made by those charged with the Water-supply of cities and dwellings.

(2.) Water-supply is a thoroughly “popular” question—in the sense that in some form or other it affects the welfare of every individual, whether resident in country or town. Water is one of the most powerful of all sanitary and insanitary agents—one of the most certain conveyers and producers of *Disease and Death*. Its influence for weal or woe on the public health—and be it remembered always that *Health is Wealth*—cannot be over-rated, though it is only the *Physician*, who can gauge the real amount of good it is capable of doing where properly used, or of evil that it creates when improperly employed.

(3.) Water-supply is a subject with which I am personally very familiar, having had occasion as a Physician, and as Officer of Health to various large communities, to study the question in all its bearings. It is nearly twenty years since I proposed the establishment, on the Kinnoull side of Perth, of a River-side Engine-Pump in connection with a High-level Reservoir, for the supply of a single edifice on the slope of Kinnoull Hill with water suitable as to both quantity and quality. The original outlay would have been only about £1000, which might have been made to “pay”

itself over and over again in the interim, even in money, by the supply of water to houses in Bridgend. But this would not have been either my first or main object. A Physician has nothing to do directly with mere "pay," though none knows so well as he that everything conducive to individual and public *health* is the truest—and, indeed, the only real—*Economy*. It is also nearly twenty years since, under the auspices of the late well-known Professor George Wilson, of Edinburgh—one of my old Teachers of Chemistry—I had occasion to expose certain serious errors in domestic Water-supply before the Chemical Section of the British Association. The investigation on which the said exposure and denunciation were founded was made in Perth, and the details were fully published, and have been amply quoted by writers on Sanitary Science. Moreover, some of the practical illustrations of the grave errors committed by architects and plumbers in regard to Water-supply, as eliminated in the course of the inquiry in question, have long been numbered among the curiosities of the National Museum of Science and Art in Edinburgh. It so happened that among the pleasant and profitable results of that Investigation—its Publication and Discussion,—I was brought into contact or communication with two of our foremost sanitary authorities—Professor Parkes, of the Army and Navy Medical School at Netley, near Southampton, the author of the very best Text-Book on Public and Personal Hygiene; and Dr Richardson, of London, whose sketch of a model *Hygeia* attracted so much notice lately at the Social Science meeting in Brighton, and who is the author of a work on the "Diseases of Modern Life," and of many other important works. Thus I know that the views to be hereinafter expressed are not singular, and that the language in which I express them is far from being so strong as the facts of the case might warrant.

(4.) I venture to add that the Water-supply of Perth and its suburbs is a question on which I have a right to speak out as a resident for upwards of twenty-one years in the neighbourhood, and as a sufferer from the ignorance, apathy, or incapacity of the authorities—whoever they may be—and they are various—who are or have been charged with the great responsibility of providing the city and its environs with suitable Water for domestic and other purposes. I have had ample personal experience of several different kinds of Water-supply in and near Perth, having resided in Marshall Place, Perth, as well as in various localities on the slope of Kinnoull Hill. I have thus had the opportunity of tasting and testing for myself the Perth town supply; the Muirhall Quarry water, as provided to the villas at Kinnoull; various well waters on Kinnoull Hill; besides certain surface and rain waters. All of these waters are *bad in quality*—though in various degrees—both absolutely and comparatively—even assuming their quantity to be satisfactory. Absolutely, in so far as they contain salts or decomposing organic matter that render them for certain uses objectionable. And stil

more comparatively, considering the ample and suitable Water-supply that *might, and should*, be provided to Perth and *all its suburbs* from the Tay that flows past our very doors, and is allowed to carry its superabundant floods as a *waste material* to the ocean!

In dealing with such a subject as Water-supply, its paramount importance in the eyes of the experienced Physician is such that it is almost impossible for him to resist the strong temptation to descant, by way of preliminary, on the magnitude of the Evils which Man induces in himself by the *non-use or abuse* of the single,—but by no means simple,—element of Water. I must keep in mind, however, the place in which, and the audience to whom, this Address is being delivered. My own opinion is very strongly that the time of such a Society, on such an occasion as the present, should not be consumed by listening to elaborate Dissertations, abounding in proof and quotation, by any single individual, but rather that *all* the Members should be encouraged or stimulated to take part in *Discussion*. This, I think, may, in connection with so popular a question as Water-supply, be accomplished by submitting a series of *Propositions* calculated to excite *Debate*, involving as they do points regarding which honest differences of opinion may be expected to exist. I prefer, therefore, not at present to go into any *Detail*—not to give proofs or grounds for all that I assert. At the sametime, it is advisable distinctly to advertise that it is from no lack of such proofs or grounds that I do not now adduce them. Ample evidence of the nature of the Water-supply of Perth has been given, as already stated, elsewhere, and by others as well as myself. So that it is certainly not because its Defects have not been pointed out that the shortcomings of the Perth Water-supply, or of the authorities charged with its supervision, have not long since been remedied! Did time permit, and proper opportunity offer—I would be glad to show how, while smaller towns—and villages even—in all parts of Scotland have been vigorously improving *their* Water-supply, to the obvious amelioration of the Public Health, *Perth* has, in more senses than one, for years been “sticking in the mud.”

I will confine myself, then, on the present occasion, to the enunciation of a series of *General and Special Propositions* anent Public Water-supply—the first, relating to the Water-supply of all Towns, or Towns in general; the latter, to that of Perth and its suburbs in particular.

It may be well, however, before enumerating and supporting these Propositions, to explain that I treat my subject so far in the abstract, and not in reference to this or that Public Body, that may or may not be to blame for the very manifest and many *defects* of the Perth Water-supply. It is fortunate—at least for myself—that I have neither Taste nor Time for the study of local civic or municipal literature: that I see only one Perth newspaper: and that though I notice frequent references in it to differences of opinion between different Public Bodies, or Pri-

vate Individuals, on the vexed question of Water-supply, I am not in the habit of reading the newspaper or other accounts of petty local squabbles. I am, therefore, not in a position to apportion the Culpability, that I nevertheless believe to be attachable to those who, having it in their power to provide Perth with an ample supply of suitable Water, have hitherto signally failed to do so.

I. GENERAL PROPOSITIONS.

1. Water-supply, whether Public or Private, for a city or a dwelling, should be *practically unlimited*. *Abundance* of Water is required, not only for Drinking and Cooking, but for Bathing, Washing clothes, Flushing W.C.'s, Drains and Sewers, Closes and Streets;—and, in cities, for a host of Manufacturing purposes.

2. Where it is necessary or desirable to fix a *Minimum Standard*, there should not be less than *50 gallons per head* of the Population *per day*, for all purposes. In proportion as a Water-supply falls below this regular daily amount, it is to be regarded as *inadequate or defective*.

3. When a large important River—fed by Highland Lochs—flows through a town, there is *no proper excuse* for the absence of an unlimited supply of suitable Water.

4. Much life, health, and happiness are *sacrificed* to or by insufficient or improper Water-supply in this country; and a heavy *Responsibility* thus devolves on those whose *Duty* it is to provide a supply of so essential a Sanitary element as Water, suitable in the double respect of *Quantity and Quality*.

5. Deficient *Quantity* and improper *Quality* in Water-supply are *expensive* to a community—

(a) By the sacrifice of Life or Health, and the loss thereby of valuable productive labour.

(b) By direct outlay— for instance on Soap and Soda, or other material—in the use of *Hard* waters for the washing of clothes, for cooking, and for boiler purposes.

(c) By the enormous waste of force, time, and money involved in the mere mechanical work of pumping and carrying water; waste which would be prevented by a proper *Gravitation* supply.

(d) By the destruction of *Lead*, or other material used in the construction of cisterns or manufacture of pipes, on which water—soft or hard, cold or hot—acts detrimentally.

6. The same *Quality* of Water is not required for different domestic, municipal, or manufacturing purposes. Thus

(a) For Cooking food and Washing clothes, *soft* water is desirable.

(b) For Drinking, that which is slightly *hard* is permissible.

(c) For Flushing and cleansing, and for many public works, Purity is of less consequence than Amount—*quality* is of secondary importance to *quantity*.

7. There ought to be, in every city of 10,000 inhabi-

tants or upwards, a *Medical Officer of Health*, and *Public Analyst*; whose duty should include the reporting on Water-supply, and the enforcing of its adequateness both as to quality and quantity. Where it is impossible to obtain or possess a special Medical Officer of Health, or Analyst, there should at least be a *Sanitary Committee* of the leading citizens, including Magistrates, Physicians, Lawyers, Clergymen, Civil Engineers, Architects, and Tradesmen—such as Builders and Plumbers.

8. Professional and practical men—such as *Architects* and *Plumbers*—who are specially charged with the construction of towns and houses, commit the most serious Errors, as to Water-supply, from their Ignorance of the chemical and mechanical properties of water, — of the Laws of Health, and the effects of Water—good and bad—on the human frame,—and of the rudiments even of the Natural and Physical Sciences. They err, for instance, in

- (a) The Storage of Water in *lead*.
- (b) Allowing access of *sewage gases* to cistern water.
- (c) Creating foci of *gaseous poison* in the form of circumscribed collections of stagnant putrid water in dwellings themselves.
- (d) Allowing access of sewage poisons from drains or sewers by faulty trapping or ventilation, or the absence of all trapping or ventilation.

The result whereof is that such men, or their ignorance, are chargeable directly with the major part of the Typhoid fever, Cholera, and certain other endemic or epidemic diseases that—in cities at least—decimate society!

9. There is at present, in most of our towns, a culpable *Waste of Sewage*, which, instead of being a source of Mischief, or a mere waste material, should become a source of Revenue, when applied, for instance, to the *Irrigation* or *Fertilisation* of rural farms and meadows.

10. Public Water-supply should be in the hands of the *Public*, or its Representatives—not of mere Private or Proprietary Companies. It should be the object of careful management by local or general Governments, whose aim should be the improvement and diffusion of Public Health, and thereby of Public Wealth; and not the mere gathering in of satisfactory dividends on a given capital outlay! In other words, Public Water-supply should never be allowed to become matter of mere *Speculation or Gain*—Public or Private.

11. In proportion as Public Water-supply is improved—as pure loch, spring, or river waters are substituted for shallow well-waters—the *Public Health* of towns of all sizes is materially improved.

12. Large Public outlay—repaid by general assessment—has, therefore, been cheerfully borne by those by whom it has been well invested, in increased duration of life, in the marked diminution of disease, and in the more general diffusion of happiness and prosperity.

13. As a rule, shallow and open *Well-Waters* are unsafe and objectionable not so much from their general excessive *Hardness*, as from the great risk of contamination

by soakage into them of manure, sewage, and other forms of *decaying organic matter*. The dangerous impregnation is sometimes such that well-waters are virtually *Diluted Sewage*. A host of recent evidence shows that *open wells* are most objectionable as the sources of Water-supply.

14. The influence of such contaminated waters on the generation of *Disease*, especially of Typhoid fever and Cholera, has been pointed out, in a special section, by the Rivers Pollution Commissioners in their last Report.

15. Water-supply, when taken from tidal rivers, should be drawn off *above* the influence of the Tides, as well as *above* sources of pollution by city sewers or public works.

16. *Filtration* should be *chemical* as well as mechanical. It should ensure the removal or destruction of everything—organic or inorganic—that might be dangerous to Public Health, or uneconomical for other Public purposes.

17. No W.C.'s should draw directly from the Mains: and there should be no possibility of *Regurgitation* of fæcal and other deleterious gases into the water—used for drinking—contained or conveyed in cisterns or pipes.

18. There should be due *ventilation* as well as Trapping of W.C.'s, Drains, and Sewers, of all kinds and sizes.

19. It is desirable, where possible, that House-supply should be from the Mains direct, so as to avoid *storage and cisterns*.

20. Where *cisterns* must be used, they should be constructed of some material on which water does not act: and they should also be duly covered, and their contents at the same time duly aerated.

21. The *cleanliness* of cisterns, whether covered or uncovered, cannot be too carefully attended to: in order to which regular (periodical) examination and cleansing are desirable.

22. *Lead* is so objectionable that it should *never be used* either in the construction of cisterns or of pipes: and so many other materials are at the command of Architects and Plumbers that there is no necessity whatever for their absurd adhesion to a metal on which water is at all times liable to act—to the risk of dangerous contamination of Water-supply.

23. Efficient means should be taken to *prevent waste* where Water-supply—in towns or dwellings—is costly and scarce.

24. Public Water-supply should always be by *Gravitation* from High Levels—that is from ample Reservoirs placed at higher levels than the highest houses to be supplied.

II. SPECIAL PROPOSITIONS.

1. The original Founders of *Perth* committed an egregious blunder in planting the city on a plain—contiguous to the River and below its level at Flood-mark!

2. But their successors of the present day are much more blame-worthy in locating not only Private Dwellings but important Public Institutions with no reference or regard to their Water-supply. The ancient inhabitants of

Perth—the ancestors of its present citizens—could not be supposed to have been acquainted with *Sanitary Science* : but now there is no excuse for ignorance of facts that are patent to the Million.

3. The *Reflux of Sewage* and its deleterious gases into the the drains underlying the streets and houses of Perth—at floods or high tides—should be prevented either by

(a) *Pumping* the City Sewage to *high levels*, and utilising it for

(1) *Irrigation* Purposes: or

(2) The manufacture of *gas* : or by what is probably preferable—

(b) The adoption of Captain Liernur's system of *Pneumatic Drainage*.

4. There ought to be in Perth—as there is in so many other, and frequently smaller, towns, a *Medical Officer of Health* and *Public Analyst*.

5. There ought to exist a complete series of *Chemical analyses* of the various classes of Waters in and around Perth: showing, on the one hand, the amount of *decaying organic matter*, and, on the other, of the salts of lime or other salts which impart the condition or quality known as *Hardness*. In the absence of any such series of analyses—accessible to, and specially made for behoof of, the the Public of Perth and its suburbs,—I subjoin a short comparative table indicating the *kind* of information that is desirable :—

Comparative *Quality* of Potable Waters, according to Professor Frankland, of London, in October, 1870.

	Total Solid Impurity,	Previous Sewage or animal contamination (estimated).	Total Hardness.
1. <i>Glasgow</i> —			
Loch Katrine,	2.40	0	0.88
Gorbals,	8.00	0	4.41
2. <i>Aberdeen</i> —			
River Dee, above Banchory, . .	4.36	0	2.03
3. <i>Perth</i> —			
River Tay, above the Bridge, . .	5.72	0	2.92
— at Bridgend, . .	16.02	21.00	7.57
4. <i>Dundee</i> —			
Monikie,	13.52	200	6.59
Ladywell,	66.90	32,280	24.22

As regards *Perth*, this Table brings out forcibly the serious and sudden contrast between the comparatively pure River-water drawn off *before it* is contaminated by Sewage, and the decidedly impure and objectionable Water.

from the same river not many yards lower down in its course, *after it* has only begun to receive the Suburban Sewage.

As regards *Dundee*, it shows the dangerous impurity of certain shallow Well-waters—compared especially with those of Highland Lochs and Rivers.

6. The Water-supply of Perth is *inadequate both as regards quantity and quality*.

7. There is *deficient* supply at all seasons, and in all states of the River, for certain Public purposes—even in the immediate vicinity of the river itself. Thus

(a) Even in the wet weather of winter, and when the River is flooded, there is insufficiency of Water—the Superintendent of Police tells us—for the *extinction of fires!*

(b) While in the Droughts of summer, when wells fail, not only Private Houses of all sizes, but large Public Institutions, are driven to the *cartage of water* from the sometimes distant—river.

8. The *quality* is objectionable, insofar

(a) As much of it is too *Hard* for use, even in Drinking;

(b) While most, if not all of it, is liable to the charge of being virtually a *Diluted Sewage*. Very much diluted it may be at certain times and in many cases, but nevertheless dangerous in proportion to the degree of its *contamination with putrescent or decayed organic matter*.

9. The amount of Danger arising from the *Quality* of Perth Water-supply stands in a ratio to its *Quantity*; so that Danger is greatest during summer-droughts when the Water-supply is lowest.

10. The Perth waters are objectionable and dangerous in the following order:—

(a) *River supply*—which is polluted by the sewage of the town;

(b) *Bridgend supply*—which is virtually a surface water, contaminated with Manure; and

(c) *Well-waters*—which, in addition to pollution by both sewage and manure, are impregnated to various degrees with salts that are noxious to health on the one hand, and uneconomical on the other.

11. In and around Perth there is a perennial *waste of Force, time, and money*, in the use of *Hard* waters alone—waste in the form, for instance, of

(a) Soap and Soda required for their softening; and

(b) The physical exertion involved in their pumpage and conveyance.

12. But what is far more serious—there is a gratuitous and culpable *waste of Human Life, Health, and Happiness*, by the generation and propagation of *preventible disease* of the zymotic type—arising from

(a) The scarcity of water.

(b) Sewage Poisoning.

(c) The use of polluted Waters for Drinking and Cooking.

13. With the Tay,—fed by so large a body of water as Loch Tay—flowing almost through its streets,—the Water-supply of Perth ought to be at least as ample and as pure as that of Glasgow, Edinburgh, and Aberdeen.

14. There should be two *High-level Reservoirs* on the heights or hills above or around Perth—the one on Craigie, the other on Kinnoull Hill,—at such elevations and of such capacity as will enable them to supply by *gravitation* not only all Perth, but *all its suburbs—present and prospective*. If one such Reservoir would suffice for the supply of *both* sides of the river, good and well. That is a question of detail for Engineers :—one on which there is nobody in Perth better qualified to speak with authority than the worthy Secretary of this Society.

15. While Perth shows an apparent partiality for impure waters, it is even more decidedly addicted to the use of “strong waters.” Were the money that is annually squandered—in and around what is very far from being in a sanitary sense a “Fair City”—on the purchase of whisky and other unnecessary and mischievous alcoholic stimulants—devoted to the introduction of a proper Water-supply, the probability is that no general assessment—no Public Taxes—for the latter purpose would be requisite !

16. On the whole—considering especially—

- (a) What has been done of late years, or is now being done, as regards suitable Public Water-supply, by smaller towns or villages—including Dunfermline, Dumbarton, Elgin, Crieff, Stirling, Kilmarnock, Motherwell, Pollokshaws, Port-Glasgow, Burntisland, Ladybank, Galashiels, Coupar-Angus, Airdrie, Ayr, Hamilton—which are usually at a distance — sometimes of many miles — from the source of supply:
- (b) The Insalubrity of Perth, and its liability to Typhoid fever and other *preventible* endemic or epidemic diseases of the zymotic class: and
- (c) The amount and quality of the Water offered so lavishly by the Tay and its feeders—

the Water-supply of Perth must be regarded as a Disgrace to a City of its size, age, population, and pretensions !

Having, then, by the enunciation of a body of general and special Propositions, discharged what I have conceived to be my own Duty and Privilege in bringing under your notice some subject worthy of your attention, and calling for your discussion—I must leave it to you—the Members of the “Perthshire Society of Natural Science”—to ventilate the important question of the *Perth Water-supply : what it is, and what it ought to be*—in the proper quarters, and in a suitable manner: and to bring the force of *Public Opinion* to bear, in due time, on those authorities—whoever they may be—who, charged with providing to Perth and its environs Water abundant as to Quantity, and pure as to Quality, yet appear to be so ignorant of, or so indifferent to, the importance of their Duties or Privileges !

